earlier and some that can safely run longer and finally recover without operation.

(C) The history of the case and the general signs and symptoms. In the history of the case the following points are worthy of note: mastoiditis following the acute infectious diseases is insidious in its onset and greater destruction is apt to result before pronounced signs and symptoms arise. This is likely due to the impaired resistance and is especially pronounced in scarlet fever, measles, and typhoid fever. A history of present or past tubercular trouble is important, for tubercular mastoid destruction is difficult to cure and recurrences are more frequent. A history of diabetes makes the prognosis more grave. The tendency is to delay operation in such cases, even though the mastoid indications are plain. When we realize that in these very cases the resistance of the host to infection is poor it is all the more imperative to operate. The number of deaths from fatal mastoid complications secondary to scarlet fever, typhoid, diabetes, etc., prove the truth of this statement; because investigation of such cases will usually show that there was unwarrantable delay in operating. I reported such a case at the last meeting of the State Society, wherein I was at least partially to blame, as a consultant, for the man's death. It was a case of diabetes in which middle ear abscess occurred. Operation was advised, but not sufficiently insisted upon. After six or eight weeks of apparent absence of mastoid signs, a sudden convulsion occurred and death followed in twelve hours. A large epidural abscess was discovered. There is hardly a doubt but a timely operation would have saved his life.

I reported a similar case at the American Medical Association meeting (in July, 1905), with this difference, that the mastoid abscess complicated typhoid, and thrombosis of the lateral sinus was responsible for the death. Frequently are the mastoid signs thus masked by coexisting diseases.

As to the general signs and symptoms, such as chills, fever, nausea, vomiting, etc., these are rarely met with in uncomplicated mastoid cases, except in children. In adults the general signs and symptoms are of slight consequence, until intra-cranial complications arise. In infants, however, high fever, vomiting and occasionaly convulsions occur readily from middle ear suppuration. Such symptoms when otherwise not accounted for, should prompt a careful otoscopic examination. In adults, a slight but persistent rise of temperature occurring in the course of middle ear suppuration is suspicious of mastoid involvement.

As to a differential blood count, this is generally regarded to be of no value in determining upon the mastoid operation, although, of course, of great value in determining complications that produce general infection.

As to the use of vaccines: May we delay operation on the mastoid in order to await the result of curative vaccine injections, which have recently been advocated with some enthusiasm? I should like to have the opinion of those who have had greater experience in the use of vaccines in other suppurative processes. Personally, while I am trying vaccines in suitable cases, so far I have seen no positive results. While the future may possibly hold much in store for us, I believe that at present it is dangerous to postpone a mastoid operation when the indications are positive in order to await the result of vaccine injections.

In conclusion, *a timely and thorough mastoid operation,* we should remember, *serves two distinct surgical purposes—it cleans out the mastoid, including the antrum, and in so doing efficiently drains the tympanic cavity.* The latter purpose should not be lost sight of in the discussion of this subject. No one who has opened or seen opened a hundred or more mastoids can fail to be impressed with the rapidity with which the tympanum regains a normal condition after the mastoid operation. Efficient drainage in the cure of infection of other cavities in the body has become a well established surgical procedure. In ear work it is of no less importance. It is not unlikely that we will see in the next decade fewer chronic discharging ears because of more prompt operating in the acute cases.

## PROPHYLAXIS AND TREATMENT OF ACUTE OTITIS MEDIA.*

By WM. BARCLAY STEPHENS, M. D., San Francisco.

The recognition of the causes and conditions conducive to attacks of acute otitis media; their removal or prevention, or, failing in this, the rendering of their effects as innocuous as possible, constitutes prophylaxis in this disease.

Congestion of the mucus membrane of the middle ear renders it vulnerable to pathogenic bacteria, and thus liable to an otitis, whether the congestion be the result of an infectious disease, a simple catarrhal condition of the naso-pharynx or some renal or cardiac disorder. Abnormal conditions of the rhino-pharynx are by far the most common source of middle ear trouble. From this proposition the corrollary may justly be drawn that a normal rhino-pharynx is the most certain insurance against acute otitis media. Histologically speaking, the cartilaginous portion of the eustachian tube belongs more to the rhino-pharynx than to the ear; the mucus membrane being identical in kind with that of the pharynx, inflammatory conditions in the pharynx are apt to involve the tubes. At the isthmus the type of mucus membrane changes from the columnar ciliated to the tympanic form. This change in the character of the mucus membrane tends strongly to limit the inflammation at this point. This change coupled with the movement of the cilia toward the pharynx, constitutes part of nature's protection of the middle ear.

Acute otitis media is seldom a primary condition, almost invariably it is secondary to some preceding or contemporaneous inflammation of the pharynx, about the only exceptions being in infectious diseases and the accidental entrance of fluids, as in

*Read at the Thirty-Eighth Annual Meeting of the State Society, Coronado, April, 1908.

swimming, or in the use of the nasal douche. Our most fruitful prophylactic efforts then, are practically limited to one end, namely: the attainment and maintenance of a normal rhino-pharynx and adnexa. We are powerless to prevent congestion of the middle ear, arising during the course of a general disease; but we can by keeping the pharynx and tubes in a healthy state, provide the most certain deterrent to the invasion of the ear by bacteria. Healthy mucus membrane is able to care for the numerous bacteria that are normally present in the pharynx. The striving for this desideratum, a healthy naso-pharynx, should be begun in early life and be unremitting. The means to this end are to be found in hygiene, internal medication, and local treatment.

*Hygiene*—Hygiene has for its main object the prevention of "catching cold," that is, keeping up the bodily resistance so that it may not be susceptible to every draft and atmospheric change. These hygienic practices should begin in infancy. The most important of these, to my mind, are good air and plenty of it, bathing, exercise, proper food and clothing. Keep the children in the open air. Encourage them in games requiring action in the open. Give them wagons, bicycles, and go-carts; garden tools and a sand pile. Have them sleep in a room with a large amount of ventilation from one side, or if the climate is not too severe, in a properly constructed sleeping porch.

*Bathing*—Keep the skin clean and active. Accustom it to air. In addition to a weekly warm tub bath—a daily morning cold bath, either plunge or sponge, the temperature to be in accordance with the reaction; the bath to be taken quickly and followed by a brisk rub with coarse towel. If perfect re-action does not occur after a full bath, then sponge the neck and chest. Swimming under proper circumstances gives exercise and exposure of the body to the air; but must not be prolonged, and if in the surf, the ears should be protected and diving seldom indulged in.

*Clothing*—Do not swaddle in clothing; and yet have sufficient for protection. Judgment must be used. The puny, anemic individual will require more than the husky fellow with red blood rioting through his veins. Personally, I favor next to the skin, one of the light, porous, linen underwears, and in cold weather, light woolen pulled over it. It might in this day of automobiles be fitting to mention protection of the ears from the cold and rapidly moving air, especially in young children.

Certain constitutional conditions are especially prone to bring about conditions favorable to the development of acute otitis media. Each will demand its appropriate treatment, selection of which treatment will ofttimes demand the best skill of the attending physician. Of these conditions, may be mentioned, marasmus. lymphatic temperament, uric acid diathesis.

*Local Treatment*—Local treatment consists of keeping the parts free from pathological secretions and the application of appropriate remedies for the removal of the causes; the restoration of the nasal breathing in the various forms of hypertrophic rhinitis; the removal of hypertrophied tonsils and adenoids. Of the exanthemata, measles and scarlet fever are the ones in which we are most apt to have involvement of the ears, the aural condition seeming to be part of the general eruption. This we cannot prevent; but we can try to prevent the entrance of additional infection from the pharynx. Keep the pharynx and nose cleansed with alkaline antiseptic washes, followed by swabbing with one-half per cent solution argenti nitratis, or instillation of a solution of 5% to 10% argyrol, or introduce, as suggested by Weiss, 1% yellow oxide of mercury ointment into the nares. The same should be done in grip and typhoid fever. Otitis in typhoid fever is apt to occur in the fourth or fifth week of this disease. According to Oatman, this is due to the absorption of the little pad of fat in the anterior wall of the eustachian tube, thus rendering the tube more patent than normal. The same would hold true of other wasting diseases, and atrophic conditions of the nose and throat. Care should be exercised in children, who are suspectible to otitis media, in blowing the nose; especially when they have rhinitis—for it is easy to force mucus from the pharynx into the ears, through the short, straight, and rather patent tubes of early life.

It is my purpose in speaking of treatment of acute otitis media, to be practical as possible, avoiding technicalities. What is here meant by acute otitis media, is an inflammation of the mucus membrane of the middle ear, which if it does not subside, or is not aborted by remedial measures, goes on to the exudation of serum, sero-mucus, or sero-pus. In common parlance the early stage is known as earache and the later as abscess of the ear. For the relief of the pain and the cure of the disease, all sorts of expedients are resorted to by the laity, under the advice of solicitous friends and relatives. Much harm and little good is done by the various ear drops. All oily and irritant solutions are to be absolutely forbidden. The first afford excellent nutrient media for the growth of bacteria, and the second cause dermatitis of the canal. Likewise, figs, onions and various other kindred substances should not be put into the canal. I usually tell my patients that if heat applied externally, and douching the ear with hot water, does not relieve, a physician should be sent for. The instillation of hot water or a solution of cocain, are the only things I approve. Morphin may be added; but laudanum stains and prevents an accurate diagnosis, when the membrana tympani is inspected. At the outset I may say that I regard incision of the membrana tympani as the remedy, *par excellence,* in acute otitis media. However, I do not mean to say that it is necessary in every case.

Following an obstruction of the eustachian tube by a simple catarrh or by a congested adenoid, there may be, after absorption of the air, an exudation of serum into the middle ear. The rapidity with which the filling up of the middle ear with serum may oc-

cur, especially in young children, is marvelous. I have seen ears with no visible inflammation and an indrawn membrana tympani, in which an hour later the membrana tympani is bulging out and the cavity filled with serum. The inflammation of the tube being largely limited by the change of the mucous membrane at the isthmus, so that the inflammation if extending into the middle ear is of mild type and carries with it only harmless bacteria. Only the lower portion of the middle ear—the hypo-tympanum—is usually involved, and the change in the mucus membrane slight.

In this class of cases when seen early and the amount of fluid is not great, we are justified in trying to abort the attack, before resorting to a paracentesis. Calomel or castor oil should be administered. First the condition of the nose and throat is to be looked into and in fact this should be the first step in all cases of acute otitis media. First cleanse the naso-pharynx with an alkalin solution, adrenalin chlorid 1-5000, or other supra-renal capsule solution is either instilled into the nares with a pipette, or with a cotton carrier an application is made to the congested adenoid and orifice of the eustachian tube. Then the ear may be inflated with a Politzer bag with the hope that the patentcy of the tube may be restored, the adrenalin having relieved the congestion about its orifice. An application of one of the silver preparations is then made posteriorly, with a curved cotton applicator; or in case of small children, 10% solution of argyrol is instilled into the nares, with a dropper, the child lying upon its back. The object of these measures, of course, is the reestablishing of ventilation and drainage of the ear through the tube. The alkalin solution cleanses out the mucus and some of the bacteria which are usually present in the pharynx, thus rendering less likely their entrance to the ear. The method of making the alkalin application is probably worthy of note. In children, a syringe with a soft rubber tip is my choice—the child lying on its side, the solution is injected gently and allowed to flow out of the mouth and opposite nostril. In some intractable children, a small amount may be dropped into the nostril and a syringe with a large tip used to aspirate the solution and secretions from the nose. In adults or older children, a free spraying with an atomizer or a douche cup may be used. If the douche cup is used, the fluid should be introduced through the more constricted nostril and allowed to flow out through the less obstructed one. Take care not to swallow during the process or to close off the nose too much when blowing it. Dry heat applied, in the form of a hot water bag, or hot salt, or electric heating pad, is usually grateful to the patient.

These measures failing, the membrana tympani should be opened in the posterior inferior quadrant. A simple puncture is all that is necessary. Preceding paracentesis, the canal is rendered as aseptic as possible. If no anesthetic is to be administered, and in the majority of these cases none is necessary, alcohol is used for the cleansing of the canal, for the reason that it does not macerate the membrana tympani, leaving it dry and thus easily penetrated by the knife. The knife must be very sharp. The knives usually made for the purpose are rarely sharp enough, so I generally use a narrow-bladed cataract knife. The incision is made quickly, and care taken not to wound the mucous membrane of the inner wall of the ear. Done in this manner, the operation is almost without pain. The membrana tympani is often bulged out and looks like a blister. The evacuated serum is sterile or shows only innocuous organisms. The canal is now wiped out with dry cotton and sterile gauze is placed in the canal, and the ear covered with cotton. Provided that the pharyngeal condition has been remedied, the membrana tympani is closed within twenty-four to forty-eight hours. If, however, the cause has not been removed, the ear may continue to discharge for a long period, taking on a sub-acute or a chronic form, the discharge being a thick tenacious mucus.

Under these circumstances it will usually be found that an excessive amount of adenoid tissue is present and its removal will be followed by a rapid improvement in the ear condition, the otorrhea often ceasing in a day or two following the adenectomy. Irrigation may at times be necessary if profuse discharge continues. A boric acid or normal salt solution is generally used—the temperature 100° to 106° F. In these cases complications—as mastoiditis—are seldom seen, unless the ear becomes infected.

The introduction of the element of infection immediately adds to the seriousness and severity of otitis media, the severity of the attack being in proportion to the virulence of the infection, and the lack of resistance of the individual, and calls for correspondingly vigorous and prompt treatment. The question naturally follows, as to how we are to tell at the outset whether the attack is one arising from simple tubal obstruction, without any or only harmless infection, or of a more severe type. In this we are guided by the history, constitutional symptoms and age of the patient; the appearance of the membrana tympani and canal and the condition of the nose and the pharynx. If the patient is a child, and in conjunction with a cold in the head, has earache accompanied by slight or no rise of temperature, no prostration, a membrana tympani indrawn or bulging, but translucent and shining, slight injection and no involvement of the canal, a diagnosis of the simple or mild form is justified and treated accordingly. But if on the other hand, the attack comes on during the course of an infectious disease, with marked exacerbation of the constitutional symptoms, membrana tympani bulging, congested and dull, bulging of Schrapnell's membrane, adjacent portions of the canal congested, and tenderness of the mastoid, a virulent type is inferred and prompt and energetic treatment indicated. Between these two extremes will be found doubtful cases, but in case of doubt, assume to be virulent.

In these cases there is not the tendency for the inflammation to be limited to the hypo-tympanum,

but rather to spread to the contiguous parts and with the drainage through the tube shut off, the pressure of the fluid first forces out the membrana tympani. This failing to rupture, it may find its way into the mastoid cells, the labyrinth, the carotid canal, or some hiatus in the inner table of the skull or facial canal. In young children, leptomeningitis may occur through the nerve sheaths or blood vessels or sinus thrombosis through the veins. It is claimed by some that the membrana tympani of the infant is more resistant to rupture than that of the adult; be this true or not, the adjacent parts are more liable to involvement than in the adult, the mastoid antrum being almost a part of the middle ear, and the bone being so soft as to offer no resistance, when once necrosis begins.

The severity and extent of the involvement are variable, the infection not always producing the same amount of disturbance. In certain years, infectious diseases seem to take on a more severe form than in others—so with acute otitis media. There seem to be in some years and seasons more virulent types than in others; however, as we look upon scarlet fever with more dread than measles, so we would fear more a streptococcus than staphylococcus infection. There is no positive means of knowing what the infection is, until after opening of the membrana tympani. Then a smear or culture usually gives us definite information. The streptococcus, staphylococcus, pneumococcus, and streptococcus capsulatus are among the more common organisms found.

In these cases no time must be wasted in palliative measures or efforts to abort the attack, but prompt and thorough opening of membrana tympani is demanded. As a rule, a general anesthetic is necessary. The preliminary cleansing of the canal by irrigation with bichlorid 1-5000, boric acid solution or even boiled water, or with alcohol, is completed and the canal dried before anesthetising, so that advantage can be taken of primary anesthesia. If only the main cavity of the middle ear seems involved, the incision is made with a straight knife along about one-third of the posterior and inferior border of the membrane. If Schrapnell's membrane is bulging or if congested, showing trouble in the attic, a curved knife is used, following the same line of incision, but the incision is made from below upward, and the point of the knife passed on up into the attic, dividing some of the folds of mucous membrane surrounding the ossicles; or the knife can be withdrawn and a separate opening made through the Schrapnell's membrane. If there is much mastoid tenderness, I frequently turn the knife posteriorly and superiorly, and cut out through the canal, that is a modified Wilde's incision. Having opened the ear in one of these ways, we have made our best effort toward a cure and prevention of complications. If the exudate in the ear is thick and does not easily come out, the ear may be aspirated with a Siegele otoscope. Some advocate this as a routine practise, but I am as yet in doubt as to its advisability. The canal is cleaned with either cotton or by irrigation, and gauze inserted. In ordinary cases the ear is irrigated, as a rule, every three or four hours. If the discharge is profuse, more frequent syringing may be necessary or if there is mastoid tenderness, to promote the discharge, very frequent syringing with solutions as hot as can be borne.

The solution used is not so important as the way it is used—boric acid solution, 1-5000 bichlorid, boiled water or normal salt solution. I usually order for the irrigation, a syringe in the form of a rubber ball with a soft rubber nozzle. It is all in one piece and being of soft rubber may be sterilized by boiling. The attendant is directed to have the temperature of the solution, 100° to 120° F. in accordance with whether cleansing only is desired or also the effect of heat locally applied. If for the latter purpose, a fountain syringe may be substituted. The canal is straightened by traction upon the auricle and the tip of the syringe inserted one-fourth to one-half inch in the canal, and a gentle but firm and even pressure is made upon the syringe. See that there is no air in the syringe as the noise of the bubbling air is distressing to the patient. After irrigating, dry with cotton and insert a piece loosely into the canal. If mastoid tenderness continues in spite of the syringing, an ice-bag may be applied to the mastoid from twelve to twenty-four hours. If ice is not well borne, heat may be tried. I have seldom seen any benefit from the application of leeches; but if they are used, about six should be applied at once, four posteriorly and two anteriorly to the ear. The canal should be tightly plugged to prevent the leeches from taking hold there. The leeches leave the parts tender and so obscure somewhat, the presence of mastoid tenderness.

Assuming that we have had an ordinary case to deal with, following the incision of the membrana tympani, there is seen a marked cessation of the pain and constitutional symptoms, the patient in many instances having lost much rest, falls quickly into a quiet sleep. The discharge is profuse for a few days, the canal being kept clean by the irrigation. Then the discharge begins to lose its purulent character, being more scanty and mucus-like—syringing is done less frequently and presently discontinued for dry cleaning. The incision gradually closes, and the ear is restored to health in from ten days to two weeks. If on the other hand the discharge after a few days grows more profuse and purulent, and mastoid tenderness persists in spite of the douching, and application of ice or heat, and constitutional symptoms continue, the mastoid will probably have to be opened. Occasionally a day or two after opening the ear, there appears in the incision and over the membrana tympani a white membrane or exudate, which can only be removed by forceps. It re-forms in a few hours and greatly obstructs drainage. The discharge is thin and serous. I have not found any one organism in all cases. The membrane usually ceases to form after three days; but I have seen it persist for over a week. It causes much pain by obstructing drainage and also in its removal. It is possible that one

of the digestive ferments might help to cleanse off the membrane; but I have not tried them. Persistent removal with forceps has effected a cure in all cases.

In the grip, we ofttimes have otitis media, not differing from those cases occuring without the grip, except that they are more severe; but the true grippal ear is rather characteristic. The membrana tympani is apt not to be bulging as a whole; but rather in the form of blebs, either filled with clear serum or a sanguineous fluid—ecchymoses of the canal and even small hematomata—a bleb or two on Shrapnell's membrane. The membrana tympani being incised, and each of the blebs opened, there is an escape of bloody fluid and serum. Some of these blebs are on the membrana tympani and not connected with the middle ear. There is much swelling of the mucus membrane and of the submucus tissues of the middle ear, and drainage is only fairly good. The discharge is serous and continues so to the end, unless other infection is added, when it may become more pus-like and profuse. There is apt to be marked pain of the mastoid and in the muscles of the neck, persisting for several days. Iodin painted on, has given me the best results. The existing grippal infection seems to afford especially fertile soil for other infections—hence complications are common and should be carefully watched for.

In scarlet fever, involvement of the ear is common and occurs during desquamation; that is, in the third or fourth week, and the process is exceedingly rapid. It seems to be as a rule, a streptococcus infection engrafted upon the specific scarlatinal infection. Necrosis of the mucus membrane, overlying the bone, occurs early and, the bone being deprived of its nutrition, also necroses. The membrana tympani ruptures early and tends to slough away. Involvement of the mastoid and labyrinth is common. It is the most destructive form of otitis media we have, and the one yielding least to treatment. We therefore should redouble our prophylactic measures, and be most prompt in making a paracentesis.

In diphtheria, the ear is not nearly so frequently involved as in scarlet fever, and there is little tendency to spontaneous rupture of the membrana tympani.

In measles, it is fairly frequent, arising chiefly during desquamation; that is, in the second or third week. The other infectious diseases do not seem to have any especial predilection toward the production of acute otitis media, except by giving rise to congestion of the mucus membrane and so making it more liable to infection—hence reasonable prophylaxis should be exercised in these cases and in the presence of any wasting disease.

In our attention to the ear, the general bodily condition must not be neglected. See that the bowels are kept well cleared out and that proper nourishment is administered.

I desire to enter a special plea for the recognition of the importance of acute otitis media in infancy and childhood. Many an infant has died from meningitis caused by unrecognized acute otitis media and many a child has grown up with a discharging ear, or handicapped by impaired hearing from the same cause. I wish again to call attention under prophylaxis, tothe prominent place colds and abnormal conditions of the rhino-pharynx play in the etiology of acute otitis media; and under treatment, to emphasize the value of early paracentesis and the necessity of asepsis at the time of the incision, and in the subsequent treatment of the ear.

## PATHOLOGY OF ACUTE PURULENT OTITIS MEDIA AND INDICATIONS FOR OPERATIVE INTERFERENCE IN ACUTE MASTOIDITIS WITH REPORT OF INTERESTING CASES.*

By CULLEN F. WELTY, M. D., San Francisco.

In the majority of cases, the primary process in the middle ear is that of acute, catarrhal inflammation which is characterized by the presence of the exudate which develops rapidly, accompanied by more or less reaction. This effusion may be purulent or muco-purulent in character and involves the whole of the middle ear, and is usually of short duration (by the middle ear, we mean eustachian tube, tympanic cavity and mastoid cells). The anatomical changes consist of the marked hyperemia which is followed by a muco-purulent exudate into the interstitial tissue of the tympanic cavity, not so much marked in the eustachian tube and the lining membrane of the mastoid cells. This exudate in the middle ear consists of a thick, cloudy fluid mixed with mucus and pus cells, containing many blood vessels. The greatest predisposing factor in the causation of this condition is an obstruction of the eustachian tube.

However, there is another theory that is more popular to-day, and that is of germ infection. The question naturally arises, did germ infection of the middle ear cause the exudate and closure of the tube, or was the exudate produced by the closure of the eustachian tube, and afterwards infected? I am inclined to the theory of germ infection primarily. It must be accepted that acute otitis media has its origin in bacteria infection and that the diplococcus pneumonia and streptococcus pyogenes are most frequently found in the secretion and are the exciting cause of this form of infection.

The following have also been found: Staphylococcus pyogenes alba and aureus, bacillus pyocyaneus, pneumonia bacillus, bacillyus coli, menigo-coccus intercellularis, the diphtheria bacillus in middle ear diphtheria, the tubercle bacillus, the gonococcus, influenza bacillus, the typhoid bacillus in the tympanic cavity of patients who have died of typhoid fever. It was shown by Madoleczny that immediately following paracentises, the secretion cultured in a pure media showed that the streptococcus occurred, just as often alone as in combination with other pathogenic micro-organisms.

*Read at the Thirty-Eighth Annual Meeting of the State Society, Coronado, April, 1908.